PHYTOPLANKTON AS INDICATION OF ECOSYSTEM STATUS: A CASE STUDY OF AN URBAN WATERBODY[1]

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Key words: phytoplankton, ecosystem status, physico-chemical parameters

The influence of urbanisation on an aquatic ecosystem was investigated using changes in the phytoplankton species composition over the years. In addition to phytoplankton, supportive parameters such as dissolved oxygen, carbon dioxide, chlorides, hardness and nutrients (nitrates and phosphates) from the water were analysed and compared with the data from studies carried out about 16 years ago.

There was a definite shift in the algal species, as also increase in the nutrient levels. The paper discusses the types of phytoplankton species, which were once common, that have not been recorded in the present study. The appearance of a few new species indicates the changing quality of water. These findings when compared with the earlier work signify the changes in the ecosystem.

Introduction

Rapid urbanisation over the past few years has created numerous environmental problems. It is estimated that at the end of this century nearly 40% of the population will be living in urban areas, as compared to the current 25-30%. Increase in urban population has created pressure on natural resources. Most of the urban areas in a developing country like ours are spreading without proper provision of sanitation and water supply, resulting in the deterioration of water quality.

The use of an algal community to indicate trophic status has been made by many workers following the pioneering work by Kolkwitz and Marsson (1908). These authors have classified water-bodies into poly(-), meso(-) and oligo-saprobic categories. Thereafter, a number of workers began using planktonic algae to indicate organic enrichment of water bodies. A more comprehensive account was proposed by Palmer (1969). He presented a list of algal genera and species, based on which a genus or species index can be calculated. Descy (1976), reported algae to be the most important group among aquatic plants for assessment of water quality. Groups of algal species, particularly diatoms, were used to indicate quality of water by Patrick (1973). Cairns and Schalie (1980), have also suggested the use of living organisms as the best biological indicators.

Venkateswaralu *et al.* (1994), showed that growth of algal species was influenced by environmental factors and used them as indicators of pollution gradient. Gunale (1991), also used algal communities as indicators of water pollution, in a study of Mula-Mutha rivers from Pune city.

In this study we examine the changes in the phytoplankton composition and water quality of an urban lake, known as Pashan Lake, from Pune metropolitan area, which supplies water to Pashan and surrounding areas. The lake is situated on Ram river and was away from urban influence in the past. The data are compared with the previous studies of the same lake (Pingle 1976).

Material and Methods

Physico-chemical and biological analysis were carried out at monthly intervals from 5 different sampling stations covering 4 different seasons. The physico-chemical parameters have been analysed as per APHA (1989).

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TABLE 1

ALGAL SPECIES COMMON IN 1976 BUT ABSENT DURING THIS STUDY

1.	*Dictyospherium pulchellum*
2.	*Errerlla bornheniensis*
3.	*Euastrum pulchellum*
4.	*Golenkinia radiata*
5.	*Nephrocyticum agardhianum*
6.	*Sphaerocystis* sp.
7.	*Staurodesmus* sp.
8.	*Sphaerelopsis iyengarii*
9.	*Phacotus lenticularis*
10.	*Chlamydocapsa ampla*
11.	*Tetrahedron gracile*
12.	*Dinobryon sortularia*
13.	*Synura uvella*
14.	*Gymnodinium neglectum*
15.	*Arthrospira* sp.
16.	*Spirulina gigantea*
17.	*Lepocinclis texta*
18.	*Trachelomonas armata*

TABLE 2

ALGAE ABSENT IN 1976 BUT COMMON IN PRESENT STUDY

1.	*Cladophora* sp.
2.	*Ankistrodesmus* sp.
3.	*Selenastrum* sp.
4.	*Tetraspora* sp.
5.	*Gleocapsa* sp.
6.	*Gleocystis* sp.
7.	*Amphora* sp.
8.	*Volvox* sp.
9.	*Stauroneis* sp.
10.	*Mastogloia* sp.
11.	*Diatoma* sp.

Biological analysis: Plankton net of 25 mesh size was used for qualitative analysis of phytoplankton species.

The quantitative plankton analysis was done by using Lackey's (1938) drop method to calculate the percentage of each class of algae.

RESULTS AND DISCUSSION

The pH of lake water was slightly alkaline, the maximum pH value was 8.8 in summer, indicating conditions suitable for high production of phytoplankton. The total alkalinity was in the range of 246-355 mg/l. The dissolved oxygen values fluctuated from a low of 1.6 mg/l to a maximum of 8.8 mg/l in summer and winter respectively. The low value was indicative of inflow of biodegradable waste into the lake. Nitrates and phosphates also showed some increase as compared to the previous study (Table 3), indicating conversion of the water body from oligotrophic to eutrophic condition. The encroachment of macrophytic growth and seasonal blooms of certain algae also indicate a succession from oligotrophic to eutrophic condition. Absence of species such as *Synura uvella, Dictyosphaerium puchellum, Dinobryon sortulavia*, etc., which are known to occur in clean (oligotrophic) water-bodies (Gunale, 1991), also indicate eutrophication.

TABLE 3

COMPARISON OF SOME PHYSICO-CHEMICAL PARAMETERS

	Pingle 1976		This study 1993	
	Min	Max	Min	Max
pH	7.5	7.6	6.7	8.6
D.O	0.5	15.8	0.9	7.3
Tot. Alk	67.0	155.0	205.0	435.0
Chloride	0.5	31.0	24.5	81.9
Nitrates	0.0	3.67	0.09	1.25
Phosphates	0.0	0.49	0.04	0.55

(All parameters are in mg/l except pH)
D.O = Dissolved oxygen
Tot. Alk = Total alkalinity

TABLE 4

DOMINANT CLASSES OF ALGAE IN PREVIOUS AND PRESENT STUDY

	Pingle 1976	This study 1993
1. Dominant class	Chlorophyceae (40-60%)	Bacillariophyceae (30-70%)
2. Second class	Euglenophyceae	Cyanophyceae

The species which were rather common 16 years ago were not recorded in the present study (Table 1), whereas a few new species from Bacillariophyceae and Cyanophyceae are now common (Table 2). Occurrence of these algae supports the process of eutrophication. Patrick (1973) has correlated dominance of diatoms and blue green algae with increasing levels of nitrates and phosphates.

There was a shift in dominance of algal groups (Table 4). There are nearly 18 genera, which were commonly found in 1976 and are absent in 1993. Similarly, there are 9 new genera recorded such as *Amphora* sp., *Tetraspora* sp., *Selenastrum* sp. which were not found in 1976 (Table 2).

From the above discussion, it is quite clear that there was a change, both in terms of qualitative and quantitative aspects of phytoplankton. Such changes in species diversity are due to increasing inflow of biodegradable and other wastes.

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